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**Datasheet for the decision
of 29 June 2017**

Case Number: T 0973/14 - 3.4.02

Application Number: 02727601.3

Publication Number: 1393062

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Language of the proceedings: EN

Title of invention:
PROCESS FOR SMALL-SCALE TESTING OF FCC CATALYSTS

Applicant:
Albemarle Netherlands B.V.

Relevant legal provisions:
EPC 1973 Art. 54(1), 56

Keyword:
Novelty and inventive step - (yes, amended claims)



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Case Number: T 0973/14 - 3.4.02

D E C I S I O N
of Technical Board of Appeal 3.4.02
of 29 June 2017

Appellant: Albemarle Netherlands B.V.
(Applicant) Barchman Wuytierslaan 10
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted on 16 December
2013 refusing European patent application No.
02727601.3 pursuant to Article 97(2) EPC.

Composition of the Board:

Chairman R. Bekkering
Members: F. J. Narganes-Quijano
B. Müller

Summary of Facts and Submissions

- I. The appellant (applicant) lodged an appeal against the decision of the examining division refusing European patent application No. 02727601.3.
- II. In its decision the examining division referred to the appellant's request for a decision according to the state of the file and, as to the reasons for the decision, the examining division referred to the objections previously raised in the communication dated 15 April 2013. In this communication the examining division had referred, *inter alia*, to the following documents

- D2: "FCC testing philosophy", R. Pimenta *et al.*; document labelled "F-6" with the handwritten bibliographic note "Akzo Nobel Catalysts Symposium - June 1998 - Noordwijk - Holand [sic]", pages 1 to 19,
- D3: "AKZO Nobel Licenses Novel Test Units", Catalysts - Catalysts Courier, No. 47, March 2002, front page and pages 1 to 3,
- D4: US-A-4419328,
- D6: US-A-4459203, and
- D7: US-A-6069012,

and found in respect of the application documents of the sole request then on file, *inter alia*, that

- i) both document D2 and document D3 constituted state of the art in respect of the claimed invention,
- ii) the apparatus defined in independent claim 9 was anticipated by document D3, and

iii) the process defined in claim 1 did not involve an inventive step over the disclosure of document D2.

III. With the statement setting out the grounds of appeal the appellant filed sets of claims amended according to a main request and auxiliary requests I to III.

The appellant requested that the decision under appeal be set aside and a patent be granted.

IV. In a communication annexed to a summons to oral proceedings the board introduced the following document into the proceedings:

D2': "FCC testing philosophy", R. Pimenta *et al.*;
"Akzo Nobel Catalysts Symposium 1988 - June 1998 - Noordwijk - The Netherlands", Akzo Nobel Chemicals B.V. (NL), document labelled "F-6", pages 1 to 19, together with three pages showing printed bibliographic data,

and gave a preliminary assessment of the case.

V. In reply to the summons to oral proceedings the appellant, with the letter dated 22 May 2017, submitted new sets of application documents amended according to a main request and four auxiliary requests.

In reply to the observations issued by the board in a subsequent communication dated 2 June 2017 and sent by facsimile on 30 Mai 2017, the appellant, with the letter dated 2 June 2017, submitted a set of amended application documents as a new main request, the application documents consisting of claims 1 to 10,

pages 1 to 3, 3a, 4 to 6, 6a and 7 to 10 of the description, and figure 1/1.

In reply to a telephone consultation with the rapporteur on behalf of the board held on 6 June 2017, the appellant, with the letter dated 7 June 2017, submitted a new page 3a of the description and a new figure 1/1 replacing the corresponding parts of the application documents of the main request.

- VI. In view of the main request submitted by the appellant, the oral proceedings were cancelled.
- VII. Independent claims 1 and 8 of the main request of the appellant read as follows:

"1. Process for testing FCC catalysts on a small scale wherein:

- a) the feed to be cracked is heated to a temperature between 50 and 500°C,
- b) the heated feed is injected into a riser reactor containing the FCC catalyst to be tested having a temperature between 500 and 800°C, the injection time being less than 2 seconds,
- c) the feed is contacted with the FCC catalyst under fluidised conditions for a contact time of less than 8 seconds, wherein the pressure in the reactor is 135.8-308.2 KPa (5-30 psig) and
- d) the feed is stripped from the FCC catalyst and the properties of the product are analysed."

"8. Apparatus for testing FCC catalysts on a small scale comprising a riser reactor section (3) and a product collection section (4), an oil feed section (1) and a gas feed section (2), which oil feed section (1) and a gas feed section (2) are connected to the lower

part of the riser reactor section (3), which is connected to the product collection section (4), wherein the reactor section comprises a reactor (5) adapted for use at a pressure of 135.8-308.2 kPa (5-30 psig) and heating means (6), and wherein the oil feed section (1) comprises an oil storage vessel (7) and a high-pressure injection pump (8) and wherein the lower end of the reactor has a fluidisation gas inlet (9) and an oil feed/fluidisation gas inlet (10) wherein the fluidisation gas is guided to the lower end of the riser reactor both directly and together with the oil feed and wherein the high-pressure injection pump injects and atomises the feed through a nozzle into the lower end of the riser reactor with a feed injection time of less than 2 seconds."

The main request of the appellant also includes dependent claims 2 to 7 and dependent claims 9 and 10 referring back to independent claims 1 and 8, respectively.

Reasons for the Decision

1. The appeal is admissible.
2. *Main request - Amendments and formal requirements*

The board is satisfied that the application documents amended according to the present main request meet the requirements of Article 123(2) EPC and also the formal requirements of the EPC. In particular, claim 1 is based on the combination of claims 1 and 6 as originally filed; independent claim 8 is based on

independent claim 9 as originally filed together with dependent claim 6 as originally filed and the passages on page 6, lines 17 to 19 and lines 25 and 26, and on page 7, lines 2 and 3 of the description as originally filed; and dependent claims 2 to 7, 9 and 10 are respectively based on dependent claims 2 to 5, 7, 8, 10 and 11 as originally filed.

In addition, the description has been brought into conformity with the invention as defined in the claims (Article 84 and Rule 27(1) (c) EPC 1973), the pertinent state of the art (document D2) has been acknowledged in the introductory part of the description (Rule 27(1) (b) EPC 1973), and the pressure values specified in the description and in the claims have been expressed using SI units (Rule 35(12) EPC 1973).

3. *Documents D2 and D3*

- 3.1 During the first-instance proceedings the appellant disputed the examining division's view that document D2 had been made available to the public before the relevant date of the application. In the statement setting out the grounds of appeal, however, the appellant no longer disputed the finding of the examining division in the decision under appeal that document D2 was rendered available to the public in the year indicated in the document, i.e. in 1998, and that consequently the document constituted state of the art (cf. point II above, paragraph i)).

In addition, the board noted in the communication annexed to the summons to oral proceedings that although the sole bibliographic data shown in document D2 was a handwritten note reading "Akzo Nobel Catalysts Symposium - June 1998 - Noordwijk - Holand [*sic*]", the

same document had also been published in a book entitled "Akzo Nobel Catalysts Symposium 1998" containing the proceedings of "Akzo Nobel Catalysts Symposium" held in June 1998 in Noordwijk (NL) as evidenced by document D2'. In addition, document D2' also showed that the book had been made available in a public library (see stamp of the Bibliotheek Technische Universiteit of Delft on the second of the bibliographic pages of document D2'). The board expressed the view that document D2' constituted further evidence in support of the examining division's conclusion that document D2 had been rendered available to the public before the priority date of the application.

This view of the board has not been subsequently disputed by the appellant. Therefore, in view of the documentary evidence shown in document D2', the board concurs with the examining division that the content of document D2 constitutes state of the art within the meaning of Article 54(2) EPC 1973.

- 3.2 In its decision the examining division held that the set of claims then on file was not entitled to the claimed priority (European patent application 01202148.1 filed on 5 June 2001) and concluded that document D3 dated "March 2002" was rendered available to the public before the international filing date (16 May 2002) of the present application and that, therefore, it constituted state of the art in respect of the claims then on file (cf. point II above, paragraph i)).

The disclosure of document D3 contains a relatively brief technical description of the so-called "Short Contact Time Resid Test" or "SCT-RT" (see abstract of

document D3) disclosed in more detail in document D2 (see point 4.2.1 below), and the technical content of document D3 potentially pertinent to the assessment of the present case (see points 4 and 5 below) is already disclosed in document D2 (see document D3, figure on pages 1 and 2 and the corresponding disclosure in the text on the same pages, and compare with document D2, Fig. 9 and Table 11 together with section VI on pages 15 to 17). Therefore, as far as the issues that are pertinent to the present case are concerned, the relevance of document D3 does not go beyond that of document D2. For these reasons, there is no need for the board to address the question of whether the invention defined in the present claims is entitled to the claimed priority and/or whether document D3 represents state of the art within the meaning of Article 54(2) EPC 1973.

4. *Main request - Claim 1 - Novelty and inventive step*
- 4.1 In its decision the examining division did not question the novelty of the process defined in claim 1 then on file, and the board concurs with this view in respect of the process defined in claim 1 of the present main request.
- 4.2 In its decision the examining division held that the process defined in claim 1 then on file did not involve an inventive step over the disclosure of document D2 (cf. point II above, paragraph iii).
- 4.2.1 Document D2 discloses a process (see process "Short Contact Time - Resid Test" or "SCT-RT", page 15, last paragraph, together with Figure 9 and column "SCT-RT Fluid Bed" in Table 11) for testing FCC (fluid catalytic cracking) catalysts in a small scale (see

page 15, last paragraph, lines 1 and 2, and the catalyst load value of 20 to 30 g in column "SCT-RT" of Table 11, and compare with the definition of "small scale" given in the application, page 4, lines 9 and 10). In this process:

- the feed is injected into a riser reactor in a pre-heated state with an injection time of 1 second (page 15, last paragraph, lines 1 to 5), the reactor containing the FCC catalyst at a temperature in the range of 650 to 720 °C or to 750 °C (page 15, last paragraph, lines 2 and 3, and Table 11, column "SCT-RT"),

- the feed is contacted with the FCC catalyst for a contact time between 2 and 5 seconds (see "Residence time" in Table 11, and on page 15, last paragraph, line 5; see also the time intervals disclosed in Figure 9), and

- the feed is stripped from the catalyst and then analysed (see "stripping" in Figure 9, and the "product analysis" shown in column "SCT-RT Fluid Bed" of Table 11).

4.2.2 In the statement of grounds of appeal the appellant submitted that document D2 does not specify that the feed is contacted with the FCC catalyst under fluidised conditions as required by the claimed process.

However, document D2 discloses the "instantaneous mixing of ex-situ regenerated catalyst [...] and preheated feed" (page 15, last paragraph, lines 2 and 3) and teaches the skilled person to carry out the process in a "fixed fluid bed reactor" (page 15, penultimate paragraph, lines 1 and 2, see also reference to "Fluid Bed" in column "SCT-RT" of Table 11), and under "vaporization, mixing and acceleration" conditions (see Figure 9). As already noted by the

board in the communication annexed to the summons, these technical measures inherently result in the feed contacting the catalyst under fluidised conditions as required by claim 1. This view of the board has not subsequently been contested by the appellant, and the board sees no reason to conclude otherwise.

- 4.2.3 Claim 1 further requires that the feed to be cracked is pre-heated to a temperature between 50 and 500°C. In its decision the examining division held with regard to claim 1 then on file that this feature did not impart an inventive step, essentially because document D2 required the use of a feed in a pre-heated state and a catalytic cracking temperature between 650 and 750 °C, thus pointing towards temperatures of the pre-heated feed within the wide range of temperatures between 50 and 500 °C. In the statement of grounds of appeal the appellant contested this view of the examining division and submitted that document D2 did not disclose to what extent the feed should be pre-heated.

As noted by the board in its communication annexed to the summons to oral proceedings, however, document D2 refers explicitly to a pre-heated feed to be mixed with a regenerated catalyst having a temperature in the range 700 - 725 °C (see Figure 9) in a proportion of catalyst to oil between 3 and 9 (see Table 11, column "SCT-RT"), and the document also discloses that the catalytic reaction takes place at a temperature in the range of 650 to 720 °C or to 750 °C (page 15, last paragraph, and Table 11). The combination of all these conditions imposes a limitation to the extent to which the feed is to be pre-heated. In the board's view nothing inventive can be seen in the claimed temperature range because, as found by the examining division, the range encompasses values of the

temperature that the skilled person would readily consider in a straightforward way when pre-heating the feed so as to achieve the conditions required in document D2.

In the subsequent written proceedings the appellant has not contested this view of the board. The board concludes that the claimed feature relating to the feed being heated to a temperature between 50 and 500°C is rendered obvious by the disclosure of document D2.

- 4.2.4 With the statement of grounds of appeal the appellant also submitted that document D2 did not specify how an injection time of 1 second and a product residence time between 2 and 5 seconds could be achieved, thus raising the question of whether and/or to what extent document D2 constituted an enabling disclosure in respect of the mentioned features.

As noted by the board in the communication annexed to the summons, in the schematic representation of Figure 9 of document D2 the skilled person would identify the use of a riser reactor having a lower portion through which the feed is fed into the reactor. Prior-art processes for testing FCC catalysts in a small-scale reactor under these conditions by injection of the feed into the reactor (as it is also the case in the present application, see for instance present independent claim 8) conventionally involved the use of appropriate injection means, and in particular the use of an injection pump (see for instance document D4, abstract and claims 1 and 9 together with the pump 20 represented in Fig. 1 and described in column 3, lines 38 to 40 and in the paragraph bridging columns 3 and 4). The skilled person would therefore consider the use of the appropriate means, for instance of an injection

pump having the appropriate characteristics, in order to achieve an injection time of the feed of 1 second as required in document D2.

In the mentioned communication the board also noted that document D2 required a "product residence time" in the range of 2 to 5 seconds (page 15, last paragraph, line 5, Table 11, and Figure 9) and therefore a contact time below 8 seconds as required by the claimed subject-matter. According to the description of the application (page 5, lines 9 to 18), a contact time below 8 seconds was achieved by feeding the feed into the lower part of a riser reactor and mixing the preheated feed and the catalyst under fluidized conditions. As indicated above (see the previous paragraph, and point 4.2.2 above), all these features were already disclosed in document D2. As pointed out by the appellant, document D2 did not disclose injecting a carrier or fluidisation gas together with the feed into the riser reactor as specified in the description of the application (page 5, lines 9 to 18, and page 6, lines 23 to 26); however, claim 1 did not require this technical feature and, in addition, it was conventional in this art to inject the feed into the reactor together with a fluidisation gas when circumstances made it desirable, and in particular when the reaction was to be carried out under fluidised conditions (see for instance document D4, column 3, lines 35 to 37). It was also noted in the mentioned communication that there was no evidence or technical argument on file that would have supported the appellant's contention that the skilled person would have had difficulties in achieving the value of the contact time specified in document D2.

In view of all these considerations which were not subsequently contested by the appellant, the board concludes that document D2 represents an enabling disclosure for the pertinent features under consideration.

- 4.2.5 Claim 1 further requires that, when the feed is contacted with the FCC catalyst, the pressure in the reactor is in the range 135.8-308.2 kPa (5-30 psig). Document D2 contains no indication as to the pressure in the reactor during the reaction, and in the absence of evidence that the pressure in the reactor might intrinsically reach a value within the claimed range, the mentioned feature constitutes - as acknowledged by the examining division in its decision - a distinguishing feature of the claimed process over the process disclosed in document D2.

In its decision the examining division held that no technical effect was associated with the claimed range of pressure values and that these pressure values were standard in the field of FCC as shown in documents D6 and D7, and concluded that the claimed range of pressure values did not involve an inventive step.

However, according to the description of the application (see Example 1 on page 8, and in particular page 8, lines 15 to 17 and Table 1) the claimed range of pressure values improves the process for testing the FCC catalyst on a small scale in that the conversion and the product yield are close to the corresponding conversion and the corresponding product yield in a full-scale FCC unit operating at overpressure (compare in Table 1 on page 8 the pressure values, the percentage conversion values and the yield shifts of the different components in the small-scale test

process of the invention and in a full-scale FCC unit).

Furthermore, although - as held by the examining division - full-scale FCC riser reactors operate conventionally at overpressure (see for instance the table on page 2 of the description of the application disclosing a full-scale FCC reactor of the prior art operating at a pressure in the range 10-20 psig, and document D6 disclosing in the Tables A and B reactor pressure values between 34.0 and 50.0 psig), this is not generally the case in small-scale riser reactors used in testing FCC catalysts. On the contrary, document D4 is also directed to a process for testing catalysts on a small scale (abstract, and claims 1 and 9) and teaches carrying out the tests at atmospheric pressure, i.e. at a pressure of about 1 atm or 101.325 kPa (column 5, lines 4 and 5, and the introductory text of Table 2); also, in the small-scale catalyst test known in the prior art as the ASTM-MAT test and referred to in the introductory part of the application (paragraph bridging pages 1 and 2 of the application) the reaction is carried out at atmospheric pressure (see table on page 2). Document D7 directed to a small-scale catalytic cracking reactor for testing purposes (abstract) and referred to by the examining division in its decision does not allow a different conclusion because according to document D7 the structure of the reactor forms "a pressure vessel" (Fig. 1 and column 4, lines 21 to 25) coupled to a feed injector (column 4, line 26 *et seq.*), but the document does not disclose or suggest carrying out the reaction under significant overpressure conditions, let alone at a pressure within the claimed range of values.

In addition, the small-scale catalyst testing processes under consideration are not generally directed to reproduce the same conditions used in a full-scale reactor (see for instance the table on page 2 of the description; see also document D2, page 16, lines 1 to 5), but, rather, are directed to find a specific combination of reaction conditions (see in particular the conditions disclosed in document D2 with respect to the SCT-RT process and mentioned in point 4.2.1 above) in a small-scale reactor such that the results of the reaction (in particular, the conversion and the product yield) realistically emulate the corresponding results of the reaction in a full-scale reactor for the purpose of predicting the behaviour of the catalyst in the full-scale reactor. The skilled person, faced with the problem of improving in the small-scale testing process of document D2 the emulation of the conversion and the product yield of the reaction in a full-scale reactor, would then be confronted with the task of finding an appropriate combination of different conditions that would result in a better emulation of the reaction products in the full-scale reactor. None of the prior art documents on file, however, discloses or suggests solving this problem under the specific conditions already disclosed in document D2 and with a reaction pressure within the specific value range defined in present claim 1. In particular, as already noted above, document D4 teaches carrying out the tests at atmospheric pressure (column 5, lines 4 and 5, and the introductory text of Table 2), and the ASTM-MAT test mentioned in the introductory part of the description of the application (paragraph bridging pages 1 and 2 of the application) is also carried out at atmospheric pressure (see table on page 2). Furthermore, document D2 discloses, in addition to the SCT-RT test considered above, other alternative processes for testing

catalysts on a small scale (see Table 11, and the two first paragraphs of section VI), and the document also discusses different physical conditions affecting the testing processes (page 16, line 1 to page 18, last line), but there is no teaching in the document concerning the pressure in reaction conditions or its influence on the test results.

The remaining available documents of the state of the art are less pertinent.

4.3 The board concludes that the process defined in claim 1 is new and involves an inventive step over the prior art on file (Articles 54(1) and 56 EPC 1973). The same conclusion applies to dependent claims 2 to 7 directed to particular embodiments of the process defined in claim 1.

5. *Main request - Independent claim 8 - Novelty and inventive step*

5.1 In its decision the examining division held that independent claim 9 then on file directed to an apparatus for testing FCC catalysts on a small-scale was anticipated by the disclosure of document D3 (cf. point II above, paragraph ii) above). As already noted in point 3.2 above, second paragraph, the technical content of document D3 pertinent to the assessment of the present case is already disclosed in more detail in document D2, and there is no need to address the issue of whether document D3 represents state of the art in respect of the present invention. It is therefore sufficient to consider in the following the disclosure of document D2.

5.2 Document D2 discloses carrying out the process "Short Contact Time - Resid Test" disclosed in the document and referred to in point 4 above in an apparatus comprising the small-scale riser reactor represented schematically in Fig. 9 of the document. According to this figure, the feed is fed into the lower end of the riser reactor and the reaction products exit the riser reactor through its upper end.

The apparatus of the invention is now defined in independent claim 8 which, when compared with independent claim 9 considered in the decision under appeal, has been restricted in several respects (cf. point 2 above, first paragraph).

Document D2 does not disclose, at least not explicitly, the following features of the apparatus defined in present independent claim 8:

a) the apparatus comprises a product collection section connected to the riser reactor, an oil feed section and a gas feed section connected to the lower part of the riser reactor, and heating means, the oil feed section comprising an oil storage vessel and a pump;

b) the reactor is adapted for use at a pressure of 135.8-308.2 kPa (5-30 psig);

c) the lower end of the reactor has a fluidisation gas inlet and an oil feed/fluidisation gas inlet, wherein the fluidisation gas is guided to the lower end of the reactor both directly and together with the oil feed; and

d) the pump is a high-pressure injection pump which injects and atomises the feed through a nozzle.

The apparatus defined in present independent claim 8 is therefore new over the disclosure of document D2.

5.3 In addition, in the opinion of the board the apparatus defined in independent claim 8 involves an inventive step over document D2 as closest state of the art, the reasons being as follows:

Features a) and c) specified in point 5.2 above are conventionally used in the operation of riser reactors used in testing catalysts on a small-scale known in the art, as illustrated by document D4 (title, abstract, and Fig. 1, together with the corresponding description in column 3, lines 21 to 53; see in particular in Fig. 1 the product collection section 24 and 25, the oil feed section and the oil storage vessel "CHARGE OIL", the gas feed section 23, the heating means 12, 13 and 14, the fluidisation gas inlet and the oil feed/fluidisation gas inlet represented in the figure, and the pump 20). Therefore, in the opinion of the board features a) and c) are - to the extent that they are not implicitly disclosed in document D2 - obvious in this technical field.

As regards the combination of features d) specified in point 5.2 above, the board notes that injection times of less than 2 seconds are - as already mentioned in point 4.2.1 above - disclosed in document D2, and that the use of a pump for feeding the feed into the riser reactor constitutes a conventional technical measure in this art (see for instance document D4, column 3, lines 38 to 40, and point 4.2.4 above, second paragraph). However, neither document D2 nor the remaining documents on file disclose or suggest the use of a pump of the high-pressure injection type specifically arranged to inject and atomise the feed through a nozzle into the lower end of the riser reactor with a feed injection time of less than 2 seconds as required

by the claimed subject-matter. These features in combination with the remaining claimed features, and in particular with the pressure values in feature b) referred to in point 5.2 above, result in an apparatus specifically designed to carry out the process of claim 1, i.e. specifically designed to improve - as already noted in point 4.2.5 above - the emulation on small scale of the reaction results (in particular, the conversion and the product yield) in a full-scale riser reactor. In the board's view this combination of features is not rendered obvious by the available documents of the state of the art.

Therefore, the apparatus defined in independent claim 8 involves an inventive step over document D2 as closest state of the art.

5.4 The remaining documents on file are less relevant for both the issue of novelty and the issue of inventive step regarding the subject-matter of independent claim 8. In particular, the same conclusion in point 5.3 above would be reached on the basis of document D4 as closest state of the art. Indeed, neither document D4, nor a combination of document D4 with the teaching of document D2 or of any of the remaining available documents of the state of the art suggests the claimed apparatus for reasons analogous to those given in point 5.3 above.

5.5 The board concludes that the apparatus defined in independent claim 8 is new and involves an inventive step (Articles 54(1) and 56 EPC 1973). The same conclusion applies to dependent claims 9 and 10 directed to particular embodiments of the apparatus defined in independent claim 8.

6. In view of the above considerations, the board concludes that the present main request of the appellant is allowable.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to grant a patent on the basis of the following application documents:
 - claims: No. 1 to 10 filed with the letter dated 2 June 2017,
 - description: pages 1 to 6, 6a and 7 to 10 filed with the letter dated 2 June 2017, and page 3a filed with the letter dated 7 June 2017, and
 - drawings: Figure 1/1 filed with the letter dated 7 June 2017.

The Registrar:

The Chairman:



M. Kiehl

R. Bekkering

Decision electronically authenticated